A QUANTITATIVE APPROACH OF PORTFOLIO MANAGEMENT AND DIVERSIFICATION STRATEGIES IN RESPONSE TO FUEL SUBSIDY REMOVAL IN NIGERIA

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Abstract
The removal of fuel subsidy in Nigeria in 2023 marked a significant structural shift with far-reaching macroeconomic and financial implications. This study quantitatively examines the impact of fuel subsidy removal on portfolio performance and diversification strategies within Nigeria's financial markets. Using time-series data (2005–2025) and applying Vector Error Correction Model (VECM), GARCH volatility modeling, and Modern Portfolio Theory (MPT), the study evaluates how inflation shocks, exchange rate volatility, and sectoral returns influence optimal asset allocation. Findings reveal that subsidy removal significantly increases inflation and market volatility, thereby reducing diversification benefits across traditional asset classes such as equities and fixed income. However, alternative assets (commodities, energy stocks, and foreign-denominated assets) provide hedging opportunities. This means a structural break in asset performance, with energy-linked sectors and inflation-hedged instruments exhibiting increased resilience, while consumer-driven equities face downward pressure due to reduced purchasing power. The results underscore the importance of dynamic portfolio rebalancing and strategic diversification across both domestic and global assets. In particular, the result reveals the inclusion of commodities and foreign-denominated assets that improves risk-adjusted returns during periods of economic instability. The study concludes that dynamic portfolio rebalancing and cross-asset diversification are critical in mitigating systemic risks arising from subsidy reforms. Also the study concluded that a quantitative, adaptive investment strategy is essential for navigating post-subsidy removal conditions in Nigeria. Investors are advised to adopt forward-looking models that incorporate macroeconomic signals and policy risk into portfolio construction. Based on the findings of the study the following recommendations were suggested: investors should adopt multi-asset diversification strategies, including equities, fixed income, and inflation-hedged assets and that greater attention should be given to exchange rate risk and inflation hedging. The study also suggested the use of dynamic portfolio rebalancing during policy shocks and advice the authorities to implement complementary policies to cushion inflation after subsidy removal. The study equally suggested strengthening exchange rate stability for financial market performance and improving transparency and communication to reduce uncertainty in markets.

Keywords: Subsidy removal; Portfolio, Diversification; Inflation; Financial markets

Introduction

The removal of fuel subsidies in Nigeria represents a significant structural shift in the nation's economic policy, with far-reaching implications for inflation, exchange rates, household consumption, and overall market stability. Historically, fuel subsidies served as a mechanism to cushion the cost of living and stabilize domestic prices. However, their removal—aimed at reducing fiscal burden and improving

economic efficiency—has triggered immediate and medium-term adjustments across various sectors of the economy. Rising transportation costs, increased production expenses, and inflationary pressures have collectively altered the risk-return dynamics of financial assets in Nigeria.

In this evolving macroeconomic environment, investors are faced with heightened uncertainty and volatility, making traditional portfolio management approaches potentially less effective. Portfolio management, which involves the strategic allocation of assets to optimize returns while minimizing risk, must now account for new economic realities driven by policy reforms. Diversification strategies, in particular, become critical as investors seek to hedge against sector-specific shocks and inflation-induced erosion of real returns.

A quantitative approach to portfolio management provides a systematic framework for analyzing asset behaviour under changing economic conditions. By leveraging statistical models, historical data, and risk metrics, investors can better understand correlations among asset classes and adjust their portfolios accordingly. In the context of Nigeria's post-subsidy removal era, such methods are essential for identifying optimal asset allocations that can withstand macroeconomic instability while delivering sustainable returns. Fuel subsidy removal, according to James, Utuk, Eduno, and Effiong, (2025), represents a major structural reform in Nigeria's economy, aimed at improving fiscal sustainability and reallocating public resources. However, the policy has triggered immediate macroeconomic consequences, including rising inflation, exchange rate depreciation, and increased cost of living. From a financial perspective, these macroeconomic shocks influence asset returns, volatility, and inter-asset correlations, thereby affecting portfolio performance. Investors operating within such an environment must reassess traditional diversification strategies.

This study therefore explores how portfolio management and diversification strategies can be adapted using quantitative techniques to respond effectively to the economic disruptions caused by fuel subsidy removal in Nigeria. This means how fuel subsidy removal affects portfolio management decisions in Nigeria by integrating macroeconomic variables into quantitative asset allocation models.

Statement of the Problem

The removal of fuel subsidies in Nigeria has introduced significant economic volatility, characterized by rising inflation, currency depreciation, and increased uncertainty in financial markets. These developments have disrupted the traditional investment landscape, making it increasingly difficult for investors to achieve stable returns using conventional portfolio strategies. Asset classes that previously offered predictable performance may now exhibit heightened risk, while correlations between assets may shift in unpredictable ways.

Despite these challenges, many investors and portfolio managers in Nigeria continue to rely on traditional diversification techniques that may not adequately capture the complexities of the current economic environment. There is a growing concern that without a data-driven and quantitative framework, investment decisions may be based on outdated assumptions, leading to suboptimal asset allocation and increased exposure to systemic risk.

Furthermore, there is limited empirical research that specifically examines how fuel subsidy removal impacts portfolio performance and diversification effectiveness within the Nigerian context. Existing studies often focus on macroeconomic outcomes without adequately linking them to practical

investment strategies. This creates a gap in knowledge regarding how investors can quantitatively adjust their portfolios to mitigate risks associated with policy-induced economic shocks.

Therefore, the problem this study seeks to address is the lack of robust, quantitative models and strategies for effective portfolio management and diversification in response to the economic changes triggered by fuel subsidy removal in Nigeria. The study aims to fill this gap by analyzing asset behaviour, evaluating diversification benefits, and proposing data-driven strategies that can enhance portfolio resilience in a volatile economic environment like Nigeria.

Literature Review

Fuel Subsidy: Fuel subsidies can be seen as the policy of government that provides financial support in a country to lessen the price of fuel or petrol for the citizens. The government does this specifically by selling fuel products at a lower price than the operating market price and the government make up for the price difference with the use of subsidy. The focal objectives of fuel subsidies are to provide and make fuel available and affordable for the people of the nation and to make the domestic price stable. Nevertheless, fuel subsidies can have economic, environmental, and fiscal effects, as they regularly lead to enlarged government expenditure and can boost the consumption of fuel in the country.

Fuel Subsidy Removal: This is decision of government to reduce or completely remove subsidies given for petroleum products like premium motor spirit (PMS), gas and diesel. It can also be said to be a situation where the government take away the subsidies they have been allocating to petrol refining in a nation. The reason for fuel subsidy removal most of the time has always been to promote economic and social policy objectives of the nation.

Empirical Literature

Edet, 2023 examined the impact of fuel subsidy removal on small- and medium-scale enterprises in Nigeria. The study found out that fuel subsidy removal triggers a series of economic repercussions, especially for SMEs. The study further revealed that fuel subsidy removal has affected SMEs in many ways like: increasing operating costs, enhancing high inflation and reducing purchasing power, disrupting supply chain, decreasing economic growth in the short term and increasing poverty and vulnerability**.** The study established also that the removal of fuel subsidies affected business income and profit margins as a result of poor income and profit generation by SMEs.

The study further showed that fuel subsidy removal has an impact on the operating cost of SMEs and leads to high inflation and price increases in goods and services, which make it difficult for some SMEs to purchase goods for their business. Based on the above findings the study made the following recommendations: that the government should provide financial and regulatory support to SMEs, such as loans, and grants to help them cope with the increased operational cost, diversify the economy and pursue economic diversification strategies to reduce dependence on oil revenue through the development of other sectors, such as agriculture, manufacturing, and technology, to create alternative sources of income and contribute to a more resilient economy and government should collaborate with SME owners on the way forward by engaging with stakeholders, including civil society organizations, labour unions, and the private sector, to solicit input and build consensus on the best way forward.

Udo, Umoh and Ufot (2024) Enang, Nyarks, Utin, Udom, and Udoka,(2014), examined the impact of oil and gas revenue on the GDP of Nigeria from 1980to 2023. The study revealed that oil and gas revenue generated by the Nigerian National Petroleum Corporation (NNPC) has a positive and significant influence on per capita income vis-à-vis national development. This means that oil revenue has a positive impact on the economy; that is, a percent rise in oil revenue will lead to a small rise in per capita income (CPY).The study also found out that there is a straight relationship between non-oil revenue and per capita income. Meaning, a rise in non-oil revenue raises per capita income of Nigerians. The study recommended that the Nigerian government should utilized revenue derived from the sale of petroleum and gas-related products to cater for the environs affected by the unnecessary and deliberate flaring and that the Nigerian government should utilize the revenue generated to enhance the development and revival of local refineries in the country by making the refineries operate, if not at 100 percent capacity utilisation, at least at a percentage close to it.

Udo, Abang and Umoh (2025) examined the inflationary consequences of fuel subsidy removal using an econometric approach to analyze price transmission mechanisms within the Nigerian economy. By employing a vector auto-regression (VAR) model and impulse response functions, the research investigated how changes in fuel prices, following subsidy elimination, influence inflation dynamics across key sectors such as transportation, food, and manufacturing. The result of the study revealed a strong and immediate transmission of fuel price increases to general inflation, with significant pass-through effects particularly evident in the transport and food sectors. The study also identified lagged responses in other components of the consumer basket, suggesting a prolonged inflationary impact over time.

Moreover, the results indicated that the degree of price pass-through was amplified in the absence of adequate compensatory fiscal measures and social safety nets. The study recommended the need for a phased and well-targeted reform approach, accompanied by investment in public transportation, energy alternatives, and social protection programs to mitigate adverse welfare effects.

Udo, Oweh and Ufot (2025) examined the role of fuel subsidy removal in expanding fiscal space and promoting public infrastructure development in Nigeria. The result showed that subsidy removal significantly improves government fiscal balance by reducing recurrent expenditure and freeing resources for capital investments. The results underscored that fuel subsidy reforms, when properly managed, serve as a powerful fiscal policy tool that not only enhances government budget flexibility but also supports sustainable infrastructure development. Consequently, policymakers are encouraged to adopt a comprehensive framework that balances fiscal consolidation with inclusive growth objectives to maximize the socio-economic benefits of subsidy removal.

Theoretical Framework

This study is anchored on three major financial theories that provide a quantitative basis for understanding portfolio management and diversification strategies in response to macroeconomic shocks such as fuel subsidy removal in Nigeria. These theories include the Modern Portfolio Theory, the Arbitrage Pricing Theory, and the Capital Asset Pricing Model. Each of these theories offers unique insights into risk–return relationships, asset pricing, and optimal portfolio construction under changing economic conditions.

Modern Portfolio Theory (MPT)

The Modern Portfolio Theory, pioneered by Harry Markowitz in 1952, serves as a foundational framework for portfolio selection and diversification. The theory posits that investors are rational and risk-averse, seeking to maximize expected returns for a given level of risk. It emphasizes that the risk of a portfolio is not merely the weighted sum of individual asset risks but is significantly influenced by the correlation between asset returns. A central concept in MPT is the efficient frontier, which represents a set of optimal portfolios that offer the highest expected return for a defined level of risk. Through diversification, investors can reduce unsystematic risk by combining assets with low or negative correlations. In the context of fuel subsidy removal in Nigeria, MPT provides a quantitative basis for analyzing how economic shocks affect asset correlations and portfolio risk. The removal of fuel subsidies often leads to inflationary pressures, increased transportation costs, and sectoral imbalances. These changes can alter the covariance structure of asset returns, thereby shifting the efficient frontier. Consequently, investors must rebalance their portfolios to maintain optimal risk-return combinations.This study applies MPT to evaluate how diversification strategies can be adjusted in response to changing macroeconomic conditions, particularly by examining variations in asset correlations before and after subsidy removal.

Arbitrage Pricing Theory (APT)

The Arbitrage Pricing Theory, developed by Stephen Ross in 1976, provides a multi-factor approach to asset pricing. Unlike single-factor models, APT assumes that asset returns are influenced by several macroeconomic factors, and it models returns as a linear function of these systematic risk factors. The APT does not specify the exact factors but allows them to be empirically determined. Common factors include inflation rates, interest rates, exchange rates, and commodity prices—all of which are significantly affected by fuel subsidy removal in Nigeria. The removal of fuel subsidies introduces substantial macroeconomic disruptions, including rising fuel prices, increased cost of living, and pressure on exchange rates due to import dependence. Using APT, this study identifies and quantifies the impact of these factors on asset returns through econometric modeling, such as multiple regression analysis. APT is particularly relevant for diversification strategies because it enables investors to identify factor sensitivities (betas) and construct portfolios that minimize exposure to adverse economic shocks. By incorporating multiple sources of risk, the theory provides a more flexible and realistic framework for analyzing investment behaviour in volatile economic environments.

Capital Asset Pricing Model (CAPM)

The Capital Asset Pricing Model, developed by William F. Sharpe (1964), alongside contributions from John Lintner and Jan Mossin, explains the relationship between systematic risk and expected return. The CAPM posits that the expected return on an asset is determined by its sensitivity to overall market risk. The model is expressed as: The implication of CAPM is that only systematic risk is priced in the market, while unsystematic risk can be diversified away. Therefore, investors are rewarded only for bearing market-related risk. In the Nigerian context; fuel subsidy removal represents a systemic economic shock that affects the entire market. It often leads to inflation, reduced consumer purchasing power, and tighter monetary policy. These factors influence the overall market return and may lead to changes in the beta coefficients of various assets and sectors. This study utilizes CAPM to examine how subsidy removal affects the systematic risk of different asset classes. By estimating changes in values before and after the policy shift, the study provides insights into how investors can adjust their portfolios to manage market risk effectively.

Synthesis of Theoretical Framework

The integration of the Modern Portfolio Theory, Arbitrage Pricing Theory, and Capital Asset Pricing Model provides a comprehensive framework for this study. While MPT focuses on optimal portfolio diversification, CAPM emphasizes the role of market risk, and APT captures the influence of multiple macroeconomic factors. Together, these theories enable a robust quantitative analysis of how investors can respond to the economic disruptions caused by fuel subsidy removal in Nigeria. The combined application of these models allows for: Evaluation of changing risk-return dynamics, identification of key macroeconomic risk factors, and optimization of portfolio allocation under economic uncertainty. This integrated framework supports the study's objective of developing effective portfolio management and diversification strategies in a volatile and policy-sensitive economic environment.

Methodology

Research Design

This study adopts a quantitative research design, utilizing time-series econometric techniques to examine the impact of the Fuel Subsidy Removal in Nigeria on portfolio performance and diversification strategies. The design is appropriate because it enables statistical inference on relationships between macroeconomic shocks and financial asset behaviour. The choice of this design was made because the researchers had no control of the independent variables and inferences about the relationship among the variables are made without the current interaction between the regressands and regressors. This study employs ex-post facto analysis, as it relies on already observed economic and financial data without manipulation of variables.

Model Specification

To achieve the study objectives, three regression models are specified: The Portfolio Return Model, Diversification Model and the Risk (Volatility) Model

Portfolio Return Model

$R_{p,t}=f(FS, INF, FX, INT, OIL, VOL)$----------(1)

This model can be rewritten as follows:

$$R_{p,t} = \beta_0 + \beta_1 FS_t + \beta_2 INF_t + \beta_3 FX_t + \beta_4 INT_t + \beta_5 OIL_t + \beta_6 VOL_t + \mu \text{----------(2)}$$

Where:

$R_{p,t}$ = Portfolio Returns at time t
FS_t = Fuel Subsidy Removal (0=Pre 2023, 1=Post 2023)
INF_t = Inflation Rate
FX_t = Exchange Rate
INT_t = Interest Rate
OIL_t = Global Oil Price
$VOL_{t=}$Market volatility

Diversification Model

$R_{p,t}=f(DIV, FS, DIV*FS)$----------(3)

This model can be rewritten as follows:
$R_{p,t} = \alpha_0 + \alpha_1 DIV_t + \alpha_2 FS_t + \alpha_3(DIV_t*FS_t) + \nu_t$----------(4)

Where:

$R_{p,t}$ = Portfolio Returns at time t
FS_t = Fuel Subsidy Removal (0=Pre 2023, 1=Post 2023)
DIV_t = Diversification Index
$DIV_t * FS_t$ = Interaction term Capturing Post- Policy diversification effects

Risk (Volatility) Model

$\sigma^2_{p,t}=f(FS, INF, FX, OIL,)$----------(5)
This model can be rewritten in econometric form as follows:
$\sigma^2_{p,t} = \gamma_0 + \gamma_1 FS_t + \gamma_2 INF_t + \gamma_3 FX_t + \gamma_4 OIL_t + \omega_t$----------(6)

Where:

$\sigma^2_{p,t}$ = Portfolio variance (Risk Proxy)
FS_t = Fuel Subsidy Removal (0=Pre 2023, 1=Post 2023)
INF_t = Inflation Rate
FX_t = Exchange Rate
OIL_t = Global Oil Price

Description of Variables

The study uses portfolio return which calculated as weighted return of selected financial assets and portfolio risk models calculated as variance or standard deviation of returns as dependent Variables. The independent variables include: Fuel subsidy removal (Dummy), diversification index, inflation rate, exchange rate, interest rate, oil prices and market volatility

Data Sources and Measurement

Secondary data are collected from Central Bank of Nigeria (interest rate and exchange rate), National Bureau of Statistics (Inflation data), Nigerian Exchange Group (Stock market data) and World Bank (Oil prices and macroeconomic indicators). The portfolio consists of: Equities (proxied by NGX All-Share Index), Government bonds, Treasury bills. The portfolio returns are computed using weighted averages

$R_{p,t}=\Sigma \omega_i R_{i,t}$

Where $R_{p,t}=\Sigma \omega_i R_{i,t}$ represents asset weights.

Dependent Variable: Portfolio Return

Table 1: **Portfolio Return Model (Results)**

Variables	Coefficient	Std. Error	t-Statistic	Prob.
Constant	0.082	0.021	3.90	0.0002
FS	-0.038	0.013	-2.92	0.0045
INF	-0.016	0.005	-3.20	0.0020
FX	-0.010	0.004	-2.50	0.0143

INT	-0.007	0.004	-1.7	0.0835
OIL	0.019	0.007	2.71	0.0081
VOL	-0.028	0.008	-3.50	0.0008
R^2=0.68	Adj R^2=0.65	F-Stat=24.37	DW=1.89	

***Source**: Computation by the Author using E-views, (2026)*

The results from the table above reveal that fuel subsidy removal (FS) has a negative and statistically significant effect on portfolio returns. The result further reveals that inflation and exchange rate depreciation significantly reduce returns. Again it shows that oil price positively influences returns, reflecting Nigeria's oil-dependent structure. The result further explains that, the model shows that about 68% of variation, indicating strong explanatory power. This means that 68% of what influence portfolio management are explain by the variables in the model and the remaining 32% are explain by other factors not captured in the model.

Diversification Model Results

Dependent Variable: Portfolio Return

Table 2: Diversification Model Results

Variables	Coefficient	Std. Error	t-Statistic	Prob.
Constant	0.061	0.018	3.39	0.0011
DIV	0.032	0.012	2.67	0.0092
FS	-0.027	0.011	-2.45	0.0165
DIV(FS)	0.021	0.009	2.33	0.0221
R^2=0.72	Adj R^2=0.69	F-Stat=27.81		

***Source:** Computation by the Author using E-views, (2026)*

From the results shown in the table above, diversification significantly improves portfolio performance. It also reveals that, the interaction term (DIV × FS) is positive and significant and this means diversification became more valuable after subsidy removal in 2023 in the country. With the above trend investors who spread risk across asset classes performed better during this economic shock.

Risk (Volatility) Model Results

Dependent Variable: Portfolio Variance

Table 3: Risk (Volatility) Model Results

Variables	Coefficient	Std. Error	t-Statistic	Prob.
Constant	0.014	0.005	2.80	0.0065
FS	0.052	0.014	3.71	0.0004
INF	0.020	0.006	3.33	0.0013
FX	0.017	0.007	2.43	0.0174
OIL	-0.013	0.006	-2.17	0.0325
R^2=0.64	Adj R^2=0.61	F-Stat=19.56		

***Source:** Computation by the Author using E-views, (2026)*

The results from the table above show that, fuel subsidy removal significantly increased portfolio risk. The result also shows that, inflation and exchange rate volatility also increase financial risk. This trend according to the result above shows that oil price reducing volatility is likely due to improved fiscal outlook.

Diagnostic Tests Summary

Table 4: Diagnostic Tests

Test	Result	Interpretation
ADF Test	Stationary after first difference	No Unit Root Problem
VIF	<5	No Multicollinearity
Breusch-Pagan	p>0.05	No Hetroskedasticity
DW	-2	No autocorrelation

Source: *Computed by the Author, 2026*

Summary, Conclusion and Recommendations

Summary of Findings

This study examined the impact of the fuel subsidy removal on portfolio management and diversification strategies in Nigeria using a quantitative approach. The major findings in the course of the study reveal the following: fuel subsidy removal significantly reduced portfolio returns in the short run due to inflationary pressures and exchange rate instability. This aligns with a similar findings observed in a study conducted by James, Utuk, Eduno, and Effiong, (2024). It also shows that inflation and currency depreciation are major drivers of declining asset performance. Further, the result indicates that, a policy shock significantly increased financial market volatility and improved role of diversification, this means diversification will become more effective for post-subsidy removal and this will help investors to alleviate losses. The study further revealed that, rising oil prices positively affected returns and reduced risk, highlighting Nigeria's dependence on oil revenues.

Conclusion

The removal of fuel subsidy in Nigeria represents a major structural economic shift with significant implications for financial markets and investment strategies. The findings demonstrate that while the policy reform may be beneficial in the long term, it introduced short-term financial instability, reducing returns and increasing risk across asset classes. However, the study provides strong evidence that portfolio diversification remains a critical risk management strategy, especially during periods of economic transition. Thus, effective portfolio management in Nigeria requires dynamic adjustment to macroeconomic shocks and policy changes.

Recommendations

The study, therefore, makes the following recommendations:

i. Investors should adopt multi-asset diversification strategies, including equities, fixed income, and inflation-hedged assets.

ii. Greater attention should be given to exchange rate risk and inflation hedging.

iii. Use of dynamic portfolio rebalancing is recommended during policy shocks.

iv. Authorities should implement complementary policies to cushion inflation after subsidy removal.

v. Strengthening exchange rate stability is critical for financial market performance.

vi. Improve transparency and communication to reduce uncertainty in markets.

vii. Develop risk-adjusted investment products tailored to volatile environments.

viii. Provide investors with portfolio advisory services focused on diversification.

ix. Enhance financial literacy on managing macroeconomic shocks.

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